



Design for Environment

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Physics & Biology

Davenport West High School

Extern host site: John Deere

Part I: John Deere & Company

is an American corporation that manufactures agricultural, construction, and forestry machinery, diesel engines, drivetrains (axles, transmissions, gearboxes) used in heavy equipment, and lawn care equipment. As of 2014, Deere & Company employed about 67,000 people worldwide, of which half are in the United States and Canada, and is the largest agriculture machinery company in the world.

Part II: Product Sustainability Team

John Deere is committed to using the "design for environment" process and life cycle engineering to develop, produce, and deliver products and services that meet customer needs while reducing their environmental impact.

Part III: Problem

Develop a recyclability calculator tool to support environmental requests to business units across the enterprise. This project will create a tool to calculate the recyclability/recoverability rates of Deere products.

Part IV: Background

This project will require a familiarity with Life Cycle Assessment (LCA) tools, Excel bill-of-material (BOM), and the ISO 16714 terminology and calculation methods.

Part V: Business Solution

Colaborative teamwork of project engineers, graduate students, summer interns and externs.

Part VI: Student Solutions

Colaborative teamwork with lab partners and cross curricular teachers.

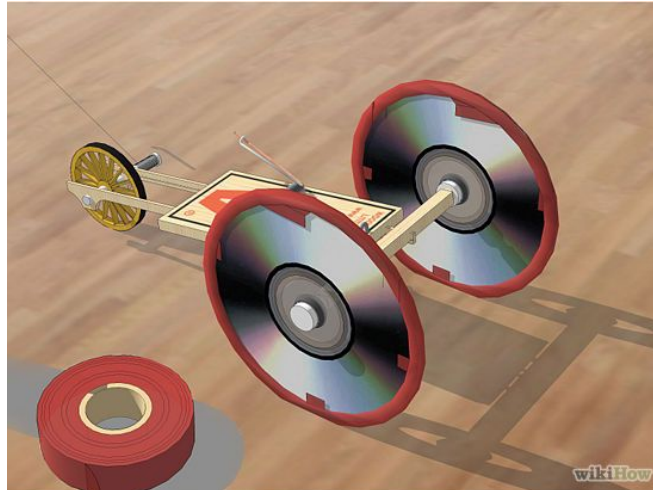
HS-PS3-3.

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Students develop a plan for the device in which they:

- i. Identify what scientific principles provide the basis for the energy conversion design;**
- ii. Identify the forms of energy that will be converted from one form to another in the designed system;**
- iii. Identify losses of energy by the design system to the surrounding environment;**
- iv. Describe the scientific rationale for choices of materials and structure of the device;**
- v. Describe that this device is an example of how the application of scientific knowledge and engineering design can increase benefits for modern civilization while decreasing costs and risk.**

Rubric	Absent 0	Emerging 1	Developing 2	Proficient 3	Superior 4
i.	absent	Mis-identifies the scientific principles underlying energy conversion	Identifies only one scientific principle underlying energy conversion	Correctly identifies multiple scientific principles underlying energy conversion	Uses scientific principles to quantize energy conversion
ii.	absent	Mis-identifies both forms of energy converted	Identifies only one form of energy that is converted	Correctly identify the forms of energy that will be converted from one form to another	Calculates the energy at multiple stages of operation
iii.	absent	Identifies energy is lost to the environment	Incorrectly calculates machine efficiency	Correctly determines energy loss by calculating machine efficiency	Shows evidence of design improvement
iv.	absent	Describes materials or structure without rationale	Describes rationale for choice of material or structure	Describes the scientific rationale for choices of materials <u>and</u> structure of the device	Describes the scientific rationale for multiple areas of structural design
v.	absent	Description is unclear or incorrect	Correctly identifies one benefit for society	Describes ways that engineering design can increase benefits for society, while decreasing cost and risk	Describes multiple ways that engineering design can increase benefits for society, while decreasing cost and risk



Each team will enter one mousetrap powered dragster. The car must meet the following requirements to qualify for competition:

The car must fit within a 30x15x15cm cube of space.

The sole propulsion of the car shall be a mousetrap.

The torque of the mousetrap cannot exceed the weight of a 500g mass at 6cm.

The mousetrap bow shall not exceed 6cm.

The car must carry a 100g mass.

The car shall maintain contact with the testing surface at all times.

The car must be self starting. (no pushing)

Scores will be determined by the formula: (distance in tiles) / (time to the 15th tile).

Distance will be measured in a straight line from the starting point.

Cars not reaching the timeline will be assigned a time twice the greatest time.

grading scale:	A	15
	B	5
	C	2
	D	1



The world is getting **greener** in its



JOHN DEERE

thinking.

Modern companies are including environmental stewardship into their design processes.



Resource consumption is being reduced through reuse, recycling or energy recovery.



Known toxins are being kept out of our food, water and air.

A carbon footprint can be product's life cycle.

calculated at every stage of a

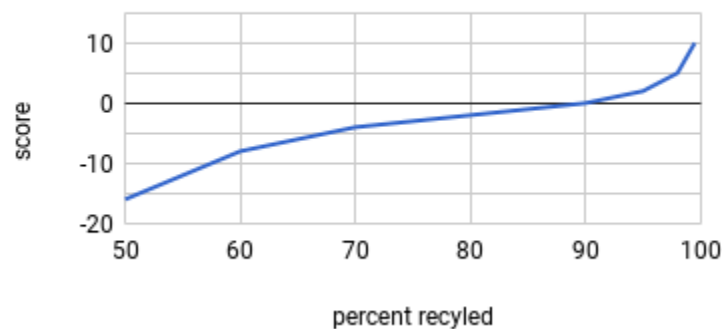


In keeping with modern environmental sensibilities, you will use a spreadsheet to create a bill of materials (BOM) for your mousetrap dragster. (click on the spreadsheet to go to the template)

Mouse trap Dragster											
level	Name	quantity	part mass (g)	total mass (g)	material	code	environ- mental factor	environ- mental cost	recovery method	waste mass (g)	
1	mousetrap	1		0	multiple	990	0.00	0		0	
2	base	1		0		#N/A	#N/A	0	▼	0	
2	spring	1		0		#N/A	#N/A	0	▼	0	
2	arm	1		0		#N/A	#N/A	0	▼	0	
2	trigger	1		0		#N/A	#N/A	0	▼	0	
2	cheese	1		0		#N/A	#N/A	0	▼	0	
1	wheel n axle	1		0	multiple	990	0.00	0		0	
2	wheel			0		#N/A	#N/A	0	▼	0	
2	axle			0		#N/A	#N/A	0	▼	0	
2	tire			0		#N/A	#N/A	0	▼	0	
2	transmission			0		#N/A	#N/A	0	▼	0	
2	other			0		#N/A	#N/A	0	▼	0	
1	transmission cable	1		0		#N/A	#N/A	0	▼	0	
1	frame	1		0	multiple	990	0.00	0		0	
2	100 g mass	1	100	100	gold	3	29574.00	0	▼	0	
2	other			0		#N/A	#N/A	0	▼	0	
			total mass =	100	total environmental cost =		0	total		0	recyclability = 100.00%

Part of your grade will be based on your recyclability score.

recyclability score



Additionally, the team with the lowest carbon footprint will receive special recognition.

